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Academic Entrepreneurship in Hungary
The Case of Biotechnology

Theses of a Doctoral Dissertation

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1. Relevance of the topic

In the 20th and 21st centuries, universities are increasingly seen as crucial actors in the economic and social development of their region (Varga, 1998; Etzkowitz and Leydesdorff, 2000; Goldstein, 2009; Youtie and Shapira, 2008). In the globalized world, to be latecomer in scientific discoveries and in turning them into products that increase the welfare of the society equals to defeat. In the age of knowledge-based economies, universities as knowledge generator and disseminator institutions, providers of knowledge infrastructure are inevitable actors in establishing the competitive advantage of a country or a region (Luger and Goldstein, 1997).

Nevertheless the transformation of universities from the middle ages' educational organisations to modern teaching and research organisations that are often considered as regional economic boosters (Florax, 1992) has been a long, gradual and sometimes even controversial process. The simultaneous conduct of teaching and research activities of faculty members are already common in most of the contemporary universities. The integration of the latest research results into education creates better job opportunities to the newly graduated, while talented students may also take part in research, extending this way the scientific frontier. However, this has not always been the case, since it was not before the 19th century that the first academic revolution extended the original teaching mission of universities with the research function (Etzkowitz, 1983). Also the term revolution suggests the controversial character of the process (Gulbrandsen and Slipersaeter, 2007); some were heavily against it arguing that research activities would divert faculty members from the more important teaching duties (Etzkowitz, 2003a). Though in some geographic areas the first academic revolution has not finished yet, in the most developed university systems another has already been started (Etzkowitz, 1998).

Changes of the world economy in the 20th century, such as the increasing importance of knowledge and changes in the methods and processes of scientific research induced a second revolution in academia that extended the already embedded teaching and research functions with the third mission: regional economic development (Etzkowitz, 1983 and 1998; Etzkowitz and Leydesdorff, 2000; Goldstein, 2009). Encouraged by the enormous scientific results achieved during the Second World War, and triggered by the fear of lagging behind in economic competition with Germany and Japan, the US government turned to universities for help (Franzoni and Lissoni, 2009).

National legislations were altered in a way as they now support entrepreneurial activities of universities. The most well-known among these is the Public Law 96-517 (the Patent and Trademark Amendment Law of 1980) or as commonly referred to the Bayh-Dole Act. The regulation, named after the senators who submitted it, granted the intellectual property rights (IPR) of research results from federally funded projects to universities. The aim was to accelerate and ensure commercial application of scientific results (Grimaldi et al., 2011). Before the Bayh-Dole Act, the IPR of federally funded research results belonged to the federal government and universities had to negotiate on a case-by-case basis which was a time demanding process (Aldridge and Audretsch, 2011).

The expectation that universities should contribute to the development of their surrounding area has not been peculiar in the US for a long time. In 1862, the Morrill Act established the model of land-grant universities by granting federally owned land to universities to support agricultural and mechanical arts through their extension activities (Etzkowitz, 1998; Etzkowitz et al., 2000; Goldstein, 2007; Mowery et al., 2004). Additionally, consultancy services and external teaching activities of faculty members have long been in effect for assisting the advancement of local communities.

However, as Gulbrandsen and Slipersaeter (2007) argued, the new types of entrepreneurial activities brought by the second academic revolution, namely patenting, licensing and spin-off are different from the more traditional ones. These are usually more controversial regarding their effect on open science, and they may require the establishment of support structures, like for example technology transfer offices. Even against the potential setbacks, many universities responded quickly to exploit the opportunity opened; they set up technology transfer offices, built science parks and established venture capital funds. The leadership in influencing regional development shifted from business to university (Etzkowitz, 1998).

More specifically, one of the distinctive features of the new academic entrepreneurial activities, that represent the so-called science-directed commercialization of university research, is the key role of individual faculty (Gulbrandsen and Slipersaeter, 2007). Etzkowitz (1998) highlighted that the evolution of entrepreneurial universities was made possible by a normative shift in the academia. This brought an era where university scientists changed their belief about the exclusivity of the ivory tower spirit. The normative turn resulted in the appearance and extension of a group of scientists who were interested

in pursuing knowledge not exclusively for its scientific truth, but also to turn inventions into commercially applicable products.

Due to the key role that scientists play in the technology transfer process, the exploration of their motivations can significantly contribute to the passage of successful policies aiming to promote academic entrepreneurship.

The selection of biotechnology as the target sector has been motivated by personal and practical reasons. The practical thought was related to the feasibility of the empirical work. One of the industries experiencing the highest level of academic entrepreneurial activity was biotechnology (Franzoni and Lissoni, 2009). The share of US academic patents in technology areas that have biomedical relevance increased from less than 25% in 1980 to some 39% in 2001 (Vincent-Lancrin, 2006). Success stories in spinning off, like that of Genentech also underpin relevance of the sector in academic entrepreneurship. Owing to the early stage of the entrepreneurial turn of Hungarian universities it was reasonable to choose a field that is likely to be active in spinning off.

The personal motivation is stemming from my visiting researcher experiences in the Research Triangle area. During my stay I carried out empirical research; I interviewed technology transfer officers of the large research universities; the University of North Carolina at Chapel Hill (UNC-CH), North Carolina State University and Duke University and Duke University. I had a conversation with an academic entrepreneur at the UNC-CH. I also visited the North Carolina Biotechnology Centre. These experiences fundamentally determined my interest in biotechnology.

2. The aim of the research and hypotheses

Based on the literature review, academic entrepreneurs seem to be different from initiators of other high-tech start-ups in the sense that personal financial gain is usually not a primary objective.

Instead a simple profit motivation, academic entrepreneurs are triggered by a set of motives where academic considerations dominate (Franzoni and Lissoni, 2009). Additionally, it also has been proved that the academic entrepreneur is not a single sub-species of university researchers, but there are various forms of academic entrepreneurs who can differ regarding their motivations, involvement in the strategic leadership of the company, mode of the co-ordination of the academic and business activities, respectively in their basic and applied research portfolio.

Nevertheless most of the research underlying our present knowledge on academic entrepreneurship is carried out in more developed contexts. The academic entrepreneurs and entrepreneurial universities described by Etzkowitz (1983) are rooted in the American system of research. The continental European university systems seem to provide less fertile ground for academic entrepreneurs. There are only a limited number of studies available for countries with resource constrained environment or with economies and innovations systems that are more unfavourable for the development of high-technology industries in general.

Hungary is a special case in the sense that its university system has German roots with a strong impact of the Soviet model. Resulting from the German tradition the Hungarian university research bears all of the weaknesses that are typical for the continental European system and seem to counteract academic entrepreneurship, like low competition for financial and human resources, limited mobility of scientists, low level of institutional autonomy, favouritism of other PROs in the research system, rigid rules for financial rewards and promotion of scientists (Bonaccorsi, 2007; Buenstorf, 2009; Franzoni and Lissoni, 2009, Mowery et al., 2004).

These problems were further aggravated by the implementation of the Soviet model of science where the nation state determined the interactions of the industrial and academic sectors (Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000). This system was characterized by limited internal democracy and creative scientific freedom; separation of

the science into sharply divided military and civilian sector and distinct subsectors of the latter, and the exclusivity of national academies of sciences is research (Balázs et al., 1995a; Gaponenko, 1995, Inzelt, 1999).

Under these circumstances academic entrepreneurship was restricted to a limited entrepreneurial pre-history, mainly in forms of contract research and informal technology transfer mechanisms (Balázs, 1996).

Thus the aim of this investigation was to see whether classical academic entrepreneurs are present at all by now in the Hungarian university system. This seems to be likely owing to the significant changes in the legislation on higher education since the political and economic transition, respectively after the Millennium. Furthermore, we are interested in whether top-down institutional technology transfer or personal motivations dominate the Hungarian academic entrepreneurial domain. Our hypotheses are as follows.

H1: Against the relatively unfavourable conditions classical academic entrepreneurs as described by Etzkowitz (1983) can exist in the current university system of Hungary.

H2: The Hungarian university context during the transitional and post-transitional periods offered an unsupportive environment for academic entrepreneurs, thus most of the spin-offs before the Millennium are “backyard farms” and their founders are rather entrepreneurial academics as described by Meyer (2003) than classical academic entrepreneurs.

H3: The university technology transfer offices established after the legislative changes around 2003 and 2005 induced a rapid rise in academic entrepreneurship in Hungary.

3. Structure of the dissertation

The dissertation includes five chapters. It starts with an introduction that highlights the aim of the research and the personal motivations behind the selection of the topic. It also describes the hypotheses and briefly outlines the structure of the dissertation. The second chapter deals with the entrepreneurial evolution of universities. First it introduces the gradual and continuous extension of academic missions from teaching through research to regional economic development. This latter includes public service activities that have been longer present in the academic domain, like consultancy or external teaching, while academic entrepreneurial forms like patenting, licensing and spin-off – though are not entirely new – only recently experienced a drastic increase in their depth and breadth. After the activities the related types of organisations become in the focus of investigation. Departing from the mediaeval universities, we get through the classical and engaged universities to the entrepreneurial universities. The introduction of the latter provides an insight into the internal and external drivers of the entrepreneurial turn and also offers different definitional approaches of the entrepreneurial university. The entrepreneurial turn of universities coincided with the unfolding of the biotechnology industry, thus the rise of this and the role of universities and academic entrepreneurs in that is also included in the second chapter. Though the importance of biotechnology is a shared characteristic, the American and continental European entrepreneurial turns are realized in fundamentally different institutional contexts that influence the extension of the academic entrepreneur phenomenon, so also this issue is discussed.

The third chapter is devoted to the engine of the whole process; to the academic entrepreneur. It discusses in detail one of the most important elements of his entrepreneurial turn, the motivation underlying his decision to start an own company. Besides different types of motivations also further individual characteristics are discussed that seem to be common in the most successful academic entrepreneurs. Additionally, elements of the organisational environment, such as university policies, technology transfer offices, and that of the broader external environment, such as the regional milieu or venture capital funds are discussed to see all the potential factors that can have an effect on the realization of the motivations.

After providing information on the historical evolution of the Hungarian university system Chapter 4 presents the results of the empirical study that we carried out among

academic entrepreneurs in the Hungarian biotechnology sector. The introduction of the Hungarian research system allows a better understanding of the limited potential of academic entrepreneurship owing to the historical neglect of universities as research entities and the resulting lack of related experience on the institutional and partly on the individual level as well. This chapter also introduces the biotechnology sector that has a long history as a strategic branch in Hungary and provides the domain of the empirical analysis. Based on the interview data, a categorisation of the Hungarian academic entrepreneurs is provided that also refers to the effect of potential influencing factors identified in Chapter 3.

Finally, summary and conclusion close the dissertation and envisage some prospective future research avenues.

4. Methodology

An extensive literature survey was carried out to reveal the motivations of academic entrepreneurs and the process of spin-off establishment in general. These combined provided a solid ground for the establishment of a framework to investigate the motivation of Hungarian academic entrepreneurs and the factors that influence the realization of those.

The selection of the sample was based on Internet search that encompassed websites of potential parent universities and their TTOs, and that of with biotechnology and spin-off contents. We also contacted research professionals and consultancy experts active in the field of biotechnology to validate our list. At the end 22 companies were identified and 18 agreed to participate in the empirical survey. Owing to the small sample size, we decided to undertake a qualitative study and collect information via personal, semi-structured interviews. The interview guidelines included questions related to the founding motivations, just as to the effect and importance of the different factors potentially impacting spinning off based on the literature survey. The factors investigated were related to the individual and university level, respectively to the external environment and included the following elements.

Table 1. Factors influencing the realisation of founders' motivations

Individual level	Professional and personal characteristics	Scientific excellence (publication and citation)
		Seniority
	Social capital	Scientific networks
		Industrial/business networks
		Role model
		Mobility
	Entrepreneurial education and/or experience	Formal business education
		Prior invention experience
		Previous industrial collaboration
	Attitudes towards conflict with open science	Secrecy
Publication delay		
University level	Policy issues	
	Departmental norms	
	TTO, ILO	
	Science/research parks, incubators	
External environment	National and regional milieu	
	Availability of funding	Seed financing
		Business angel
		Venture capital
		State grants

Source: based on a literature survey

The information collected during the interviews were complemented with background data stemming from company and university websites and systematically analysed along the above described framework. This enabled us to validate our hypotheses on Hungarian academic entrepreneurs.

5. Research results

The most important contribution of the dissertation to the common pool of knowledge on Hungarian academic entrepreneurship is the identification of *classical academic entrepreneurs*. As in the concept of Etzkowitz (1983), these scientists are at the competitive edge of their profession, many of them are star scientist with excellent professional characteristics. In accordance with this, they are usually already at a quite high position in the university hierarchy. Consequently getting higher in this system is not an explicit aim of them, but in other aspects they are strongly influenced by academic motivations. The most frequent expression of this is the aim to extend their knowledge beyond basic research and to develop their idea into a product. Furthermore, they are interested in the advancement of the broader scientific community, since they explicitly mentioned the creation of additional income to researchers and ensuring job opportunities for the talented PhD students to avoid brain drain of the field. They also apply joint project proposals with the university that creates a mutually beneficial relationship.

Thus our *first hypothesis is accepted*; against the relatively unfavourable conditions classical academic entrepreneurs as described by Etzkowitz (1983) indeed can exist in the current university system of Hungary.

The analysis of the age structure of classical academic entrepreneurs' companies does not seem to support our *second hypothesis*, since nearly half of these spin-offs were established in the 1990s. However, the fact our sample of companies established during the transitional period does not include "backyard farm" type of firms does not necessarily exclude the possibility that they do exist. Consequently we can argue that our sample did not support our second hypothesis, however, it neither rejected it.

Further novelty of our research is that besides founding classical academic entrepreneurs it also found three more types of academic entrepreneurs in the Hungarian context. Some of them differ from classical academic entrepreneurs already in their motivations, but others are triggered by the same incentives, however, fail to fully realize those. Regarding academic motivations the closest to the academic entrepreneurs are the *academic entrepreneurs impeded by environmental factors*, since also they try to establish a symbiotic relationship between the university and the company. Their aim is to extend their university basic research towards applied direction and create a complementary

research agenda that synchronizes the university basic research targets with the applied business ones. However, some unfavourable elements of the university or external environment unable the fulfilment of both the academic and the business aims, thus the synergies remain limited.

Unlike the classical academic entrepreneurs, *unbalanced academic entrepreneurs* do not necessarily create a very close symbiosis between the university and the company, since their emphasis dominantly lays on one or another field. Those who clearly subordinate business activity to the academic work are all medical doctors who aim the development of a medical device that can improve the quality of life of patients or increase their life expectancy, while one researcher altered the focus of his career and left the university to devote himself to the development of his business.

The last group of scientists we identified shows very different characteristics and motivation than the previous ones. Unlike other researchers in our sample, *externally motivated academic entrepreneurs* are positioned in the middle or bottom segment of the university hierarchy. These researchers do not seem to have the strong internal incentive to create and develop a business enterprise that will benefit their career advancement and simultaneously provides better conditions for students and colleagues alike. Their involvement is rather motivated by the external environment and by push type of factors. Two of them were not intending to reject the initiative of the technology transfer office to undertake position in the spin-off company to be established. The third researcher clearly stated that – besides the presence of some internal incentive – the company can be comprehended as a necessity spin-off that helps to overcome resource shortage in the academic environment. The important issue is here that without the presence of strong external impetus or availability of grant support schemes for spin-offs these scientists might never have started a company.

It is important to highlight that the occurrence of the classical academic entrepreneurs is not a consequence of legislative changes, since many of these companies predate the modification of the Act on Higher Education or the enactment of the Innovation Act. This seems to suggest that, similarly to the US and Western Europe, the legislation only legalised an already existing phenomenon that is rather rooted in the development of the biotechnology industry. Nevertheless, as it has already been mentioned, the time elapsed

between the legislative changes that were part of a multiple transformation is too short to make definite statements on the role of recent regulation.

Regarding the influencing factors we can claim that role models and deep embedding into networks of scientific excellence seem to be very important in the emergence of the classical academic entrepreneurs. Consequently mobility programs enabling networking and accumulation of international experience complemented with grants supporting return to Hungary are very important. The creation of a solid academic entrepreneurial base can induce cumulative processes that enhance the practical realization of the entrepreneurial turn of the institutions that seems to lag behind compared to the individual efforts.

This lagging is partly attributable to the general deficiencies of the Hungarian research system like the severely limited autonomy and excessive bureaucracy of these institutions, that cannot be outweighed by simple modification of regulation on university IPR ownership. More fundamental changes in the selection and promotion criteria of scientists would be needed, guided by a general increase in the financial autonomy of universities.

An interesting result has been that the technology transfer offices only played an important role at the establishment of the spin-offs of externally motivated academic entrepreneurs. This is reasonable in case of the companies that predated legislative changes, but there are many in our sample that did not. This clearly shows that legislation and support schemes to establish internal organisational units for technology transfer cannot be expected to generate immediate effects. Especially, since the normative support of these offices is still an unsolved issue. The unstable financing and continuous pressure to apply for grants absorbs a significant portion of the working hours of the employees and impedes the development of a solid professional technology transfer officer base. This decreases the likelihood of a more direct personal relationship between the researcher and the officers that, in turn, derogates the chances of these technology transfer offices to successfully claim normative support for their activity, resulting in a catch-22 situation.

It is also an unrealistic expectation that these newly established offices will be able to manage the whole spectrum of the university-industry collaborations from one moment to the other. Especially, since as has been mentioned in the theoretical parts and in the description of the Hungarian research system, the informal mechanisms developed in the past are likely to operate even after the legislative changes. It is likely to take generations

until mass of researchers voluntarily turn to technology transfer offices above the required minimum – or even for that.

The missions and tasks of technology transfer offices should be reviewed in the light of the first few years of operation. Clear and explicit missions should be formulated and matched with appropriate funding. Nevertheless, it is also important to note that the approximately five years elapsed since the legislative changes enhancing entrepreneurial turn of universities and our investigation and this is not enough to judge the results, especially if we take into consideration that Clark (1998; p. XIV) “[...] viewed a decade as a minimal period of time for serious change in the way of a university to be instituted and worked out.” Additionally, most of the institutions in our sample are comprehensive, multifaculty universities that in Clark’s (1998) view might find it more difficult to move entrepreneurial than specialized, one-faculty universities.

Based on the above mentioned our *third hypothesis* can be *partly accepted*, since many companies in our sample have been established after the legislative changes. However, most of them were not inspired by the technology transfer offices, rather individual scientists seem to decide to take advantage of the opening opportunities. We also have to note that most of the new founders do not belong to the classical academic entrepreneurs, and only one of the companies initiated by a technology transfer office is established by a classical academic entrepreneur. However, we would like to emphasise again the relatively short period of time elapsed between the legislative changes and our empirical research.

Related to the national and regional milieu many academic entrepreneurs consider the lack of professional biotechnology managers as one of the crucial problems of the sector. Newly graduated economists are unprepared to manage a high-technology company, and most of the biotechnology professionals do not have business education background. The evolution of the biotechnology manager layer could be supported by the attraction of Hungarian professionals working abroad.

Maybe related to the business model and mission of the Hungarian biotech spin-offs, but venture capital does not seem to play as important role as it is often echoed. Most of the scientists try to avoid VC funding owing to the fear of losing control above the company. They are aware how VC backing mechanisms work, and many of them argue that in case of an idea with fast and high return they might will establish a separate company with VC money.

Though the need for state support in forms of grant systems is in accordance with the international trends and welcomed by the academic entrepreneurs, their double transformation would be needed. On the one hand, rationalisation of administration could help the avoidance of liquidity problems on the side of companies; while on the other hand, rethinking of the selection criteria should avoid the unjustified support of semi-market companies and spending public money without real results in form of marketable products.

6. Future research avenues

There are many promising research possibilities on Hungarian academic entrepreneurship. A future study that includes all biotechnology spin-offs not only from universities, but also from other public research organisations could provide opportunity for an interesting comparison between the spin-off activities of these two types of organisations that had very different access to research infrastructure during the Soviet influence.

It would also be interesting to see whether the other main subject area of academic entrepreneurship the ICT sector shows similar motivational patterns than biotechnology. Comparing the two most important spin-off areas could provide a better proxy to the actual depth and breadth of the entrepreneurial turn of Hungarian universities.

We think that potential conflicts and tensions would deserve more detailed analysis in the future. Interestingly they seem to be only a marginally dealt with issues in Europe compared to the US. Maybe it can be related to the different developmental level of academic entrepreneurship in the two continents. Nevertheless we think that an important extension of our related knowledge would result from the simultaneous survey of academic entrepreneurs and their non-entrepreneurial departmental and broader university colleagues to see whether the perceived and real conflicts are in accordance.

One of the most promising future research avenues would be a full survey of all research groups at every universities and public research organisations that can be relevant to biotechnology. This could complement the previous research works we have been involved in multiple ways. This could provide a more detailed insight into the real depth and breadth of academic entrepreneurial activities, including not only spin-off, but also industrial co-operation in form of contract research and patenting as well. The larger sample would enable the analysis of spatial differences and gender issues as well that was not possible in the dissertation owing to the small sample size. Maybe even more important information would be the identification of the obstacles that keep back scientists from being involved in entrepreneurial activities even against the presence of internal motivations to do so. From a policy perspective it could build the base of targeted programmes to eliminate the barriers of academic entrepreneurship in Hungary.

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